SPECIFICATION

TITLE OF THE INVENTION

DATA COMMUNICATION METHOD AND DATA COMMUNICATION SYSTEM, AND BATTERY CHARGING APPARATUS AND METHOD

5   BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a data communication system and method through which a controller and a controlled device controlled by the controller perform

10   data communication via a communication channel, and to the controller and controlled device that construct this data communication system. The invention relates further to a digital video camera and printer. The invention relates further to a method of controlling the

15   storage of driver software and a method of reading out the driver software.

This invention relates further to a battery charging apparatus capable of being connected to a communication apparatus, which is capable of performing

20   data communication via a communication channel, using this communication channel to make the connection. The invention relates further to a method of charging a battery.

Description of the Related Art

25   In a data communication system through which a controller (a personal computer) and a controlled device (a printer or digital video camera, etc.) perform data communication via a communication channel, it is

necessary to install driver software in the controller
in order to control the controlled device using the
controller. In the prior art, the user loads a floppy
disk or CD-ROM, on which driver software suited to the

5   controlled device has been stored, into a floppy disk
drive or CD-ROM drive of the controller. The driver
software is then installed in the controller by being
read out of the floppy disk or CD-ROM. However,
performing installation by loading the floppy disk or

10   CD-ROM into the floppy disk drive or CD-ROM drive is a
troublesome operation for the user. In addition, there
are occasions where the user accidentally installs
driver software not suited to the controlled device.

On the other hand, in order to send and receive

15   image data, use is made of parallel communication by
relying upon a Centronics interface or SCSI (Small
Computer System Interface), etc., and serial
communication using an RS232C, RS422 or USB (Universal
Serial Bus). With serial communication, only the

20   sending and receiving of image data is performed and
consideration has never been given to charging a battery
by utilizing an image-data communication channel. If a
battery is to be charged, a charging device must be
connected a separate power supply cable.

25   SUMMARY OF THE INVENTION

Accordingly, a first object of the present
invention is to so arrange it that installation of
driver software (a program for controlling an

input/output unit or for performing a data transfer with an input/output unit) can be performed in comparatively simple fashion.

A second object of the present invention is to provide a battery charging apparatus capable of being connected to a communication apparatus, which is capable of performing data communication via a communication channel, using this communication channel to make the connection, as well as a battery charging method.

A first invention is to provide a data communication method through which a controller and a controlled device controlled by the controller perform data (inclusive of image data and audio data) communication via a communication channel.

In accordance with this data communication method, driver software of a plurality of types is stored in a storage area of the controlled device (e.g., a digital video camera or a printer).

The controller judged whether driver software suited to the controller has been stored in a predetermined first storage area of the controlled device. In response to a judgement by the controller to the effect that driver software suited to the controller has been stored in the controlled device, the driver software suited to the controller is read out of the first storage area, data representing the driver software read out is transmitted from the controlled device to the controller, and the transmitted data

representing the driver software is stored in a second storage area of the controller.

A first aspect of the present invention is to provide a data communication system suitable for

5   implementing the data communication method described above.

The data communication system according to the present invention is for communication of data between a controller and a controlled device via a communication

10   channel.

The controlled device is provided with a first memory capable of storing driver software of a plurality of types.

The controller comprises a second memory for

15   storing driver software, judgement means (a judgement device) for judging whether driver software suited to the controlled device has been stored in a predetermined first storage area of the first memory, readout means (a readout device), responsive to a judgement by the

20   controller to the effect that driver software suited to the controller has been stored in the controlled device, for reading the driver software suited to the controlled device out of the first storage area, transmission control means (a transmission control device) for

25   transmitting data, which represents the driver software read out by the readout control means, from the controlled device to the controller, and storage control means (a strage control device) for receiving the data

representing the driver software transmitted by the

transmission control means, and storing this data in a

second storage area of the second memory.

The controller or controlled device constructing

5   the data communication system described above may each

be constructed as a stand-alone device.

In accordance with the first aspect of present

invention, driver software of a plurality of types is

stored in the controlled device described above. It is

10   judged whether driver software suited to the controller

which performs data communication with the controlled

device has been stored among the plural types of driver

software. If driver software suited to the controller

has been stored, this driver software is read out of the

15   controlled device and transmitted to the controller.

The transmitted driver software is stored in the

controller to complete installation.

In accordance with the first aspect of present

invention, the labor involved in installing driver

20   software, which is for performing data communication

with a controlled device, in the controller is

eliminated. Installation of the driver software can be

executed without a troublesome operation being required

of the user. In addition, driver software not suited to

25   the controlled device can be prevented from being

installed in the controller.

An arrangement may be adopted in which it is judged

beforehand whether driver software suited to the

controller has not been stored in the controller, and in response to a judgement to the effect that the driver software has not been stored, it is judged whether driver software suited to the controller has been stored
5   in the first storage area of the controlled device.

If, upon judging whether installation of driver software is required or not, it is found that installation is required, then installation is carried out. This makes it possible to prevent the re-
10   installation of driver software that has already been installed.

It is preferred that in response to a judgement to the effect that driver software suited to the controller has not been stored in the first storage area of the
15   controlled device, information relating to the result of the judgement is communicated to the user.

As a result, the user can be notified of the fact that driver software cannot be transmitted from the controlled device to the controller, as a result of
20   which processing for installing the driver software cannot be executed. In this case, the user would load a floppy disk or the like, which stores the driver software suited to the controller, into the controller to perform installation of the driver software.

25   The above-mentioned communication line may be a cable in accordance with the IEEE (Institute for Electrical and Electronic Engineers) 1394 standards, and data representing the driver software may be transmitted

in accordance with IEEE 1394. As a result, the data
representing driver software can be sent and received at
a comparatively high speed. Installation of the driver
software is speeded up as a result.

5   It is preferred that the driver software stored in
the controlled device be rewritable. This would make it
possible to update the driver software.

It is preferred that the address of driver software
that has been stored in the first storage area and
10   information (the operating system used by the
controller, etc.) relating to the controller capable of
performing control using this driver software be stored
so as to be capable of being read out.

By thus reading out the above-mentioned address as
15   well as the information relating to the controller, the
driver software can be read out again in comparatively
simple fashion.

As many apparently widely different embodiments of
the present invention can be made without departing from
20   the spirit and scope thereof, it is to be understood
that the invention is not limited to the specific
embodiments thereof except as defined in the appended
claims.

According to a second aspect of the present
25   invention, there is provided a charging apparatus
capable of being connected to a communication apparatus,
which is capable of performing data communication via a
communication channel, using this communication channel

to make the connection, wherein the communication channel includes a communication line for data communication and a power supply line for supplying electric power, the apparatus having a charging circuit

5 for charging a battery by being supplied with electric power through the power supply line.

According to the second aspect of the invention, there is also provided a method suited to the charging apparatus defined above.

10 Specifically, a method of charging a battery according to the present invention comprises connecting a charging apparatus, which includes a charging circuit, to a communication apparatus capable of performing data communication via a communication channel that includes

15 a communication line for data communication and a power supply line for supplying electric power, the connection being made using the communication channel, and charging a battery by supplying electric power to the charging circuit through the power supply line.

20 In accordance with the second aspect of the invention, the charging apparatus can be connected to a communication apparatus, which is capable of performing data communication via a communication channel, using the communication channel. The communication channel

25 includes a communication line for data communication and a power supply line for supplying electric power. Supplying the charging circuit with electric power through the communication line makes it possible to

charge a battery. A power supply cable need not be connected separately of the communication channel.

Preferably, it is judged, based upon the power supplying capability of the communication apparatus,

5 whether charging by the charging circuit is possible, and charging the battery by the charging circuit in response to a judgement to the effect that charging is possible.

Preferably, it is judged, based upon the level of

10 electric power supplied from the power supply line, whether a decline in supplied power will occur in the power supply line, and performing an adjustment to reduce amount of charging by the charging circuit in response to a judgement to the effect that a decline in

15 the supplied power will occur.

When the power supplying capability is low, it is possible to prevent data communication from being interrupted by a decline in supplied power caused by charging being carried out by the charging circuit.

20 According to a third aspect of the present invention, there is provided a charging apparatus capable of being connected to a communication apparatus, which is capable of performing data communication via a communication channel, using this communication channel

25 to make the connection, wherein the communication channel includes a communication line for data communication and a power supply line for supplying electric power, the apparatus having a charging circuit

for applying electric power, with which it is supplied
through the power supply line, to a connector of a data
processing unit driven by an installed battery, the data
processing unit being formed to have the connector in
5   order to input electric power for charging the battery.

According to the third aspect of the invention,
there is also provided a method suited to the charging
apparatus defined above.

Specifically, there is provided a method of
10   charging a battery using a charging apparatus capable of
being connected to a communication apparatus, which is
capable of performing data communication via a
communication channel, using this communication channel
to make the connection, wherein the communication
15   channel includes a communication line for data
communication and a power supply line for supplying
electric power, the method including applying electric
power, which is supplied through the power supply line,
to a connector of a data processing unit driven by an
20   installed battery, the data processing unit being formed
to have the connector in order to input electric power
for charging the battery, the battery being charged by
the electric power applied.

In accordance with the second aspect of the
25   invention, a battery can be charged while still
installed in a data processing unit driven by the
installed battery.

Other features and advantages of the present

invention will be apparent from the following

description taken in conjunction with the accompanying

drawings, in which like reference characters designate

the same or similar parts throughout the figures

5   thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram illustrating the

electrical configuration of a communication system

according to a first embodiment of the present_

10 invention;

Fig. 2 illustrates the content of an EEPROM

included in a device, namely the content of a bus

information block and root directory;

Fig. 3 illustrates the content of an EEPROM

15 included in a device, namely the content of a unit

directory;

Fig. 4 illustrates the content of an EEPROM

included in a device, namely the content of a unit-

specific information directory;

20   Fig. 5 illustrates the content of an EEPROM

included in a device, namely the content of a driver-

software information directory;

Fig. 6 illustrates the content of an EEPROM

included in a device, namely the content of a driver-

25 software archive area;

Fig. 7 is a flowchart illustrating the procedure of

processing for installing a device driver;

Fig. 8 is a block diagram illustrating a second

embodiment of the present invention and showing a

charging apparatus, a personal computer and a

communication apparatus interconnected by a cable in

accordance with IEEE 1394;

5   Fig. 9 illustrates the format of a self-

identification packet; and

Fig. 10 is a block diagram illustrating another

embodiment of the present invention and showing a

charging apparatus, which is connected to a digital

10 camera, and a personal computer connected to the

charging apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

(1) First embodiment

A preferred embodiment of the present invention

15 will now be described with reference to the drawings.

Fig. 1 is a block diagram illustrating the

electrical configuration of a communication system

according to a first embodiment of the present

invention.

20   In this communication system, a device 20 (a

printer or digital video camera, etc.) and a device

controller 10 for controlling the device 20 are

connected by a cable in accordance with IEEE 1394.

The device controller 10 has its overall operation

25 supervised by a CPU 13. The device controller 10

includes a communication control circuit 11 for

performing a data transfer in accordance with IEEE 1394,

a display unit 14 whose display is controlled by the CPU

13, and a memory 15 for storing an operation program and other necessary data.

The device 20 has its overall operation supervised by a CPU 23.

5   The device 20 includes a communication control circuit 21 in such a manner that data transfer in accordance with IEEE 1394 is possible. The communication control circuit 21 is connected to the CPU 23 via a bus bridge 22. The device 20 further includes

10   an EEPROM 24 storing driver software for controlling the device 20 by the device controller 10, as well as other data (the details of which will be described later), and a main memory 25 for temporarily storing data (image data, audio data, etc.) transmitted from the device

15   controller 10.

Figs. 2 through 6 illustrate content stored in the EEPROM 24 of the device 20.

Fig. 2 illustrates the content of a bus information block and root directory, Fig. 3 illustrates the content

20   of a unit directory, Fig. 4 illustrates the content of a user-specific information directory, Fig. 5 illustrates the content of a driver-software information directory and Fig. 6 illustrates the content of a driver-software archive area.

25   As shown in Fig. 2, a bus information block stores a flag indicating the size of the bus information block, data indicating CRC (cyclic redundancy check) data length, a CRC value of the EEPROM 24, bus name (since

the device 20 and device controller 10 are connected by a cable in accordance with IEEE 1394 in this embodiment, this fact is stored here), data representing whether communication of isochronous data is allowed or not, a

5 reserve area, speed of the cycle clock of a cycle master (here the device controller 10 is the cycle master), payload size of isochronous data, printer maker ID and interface hardware ID.

The root directory stores a flag indicating the

10 size of the root directory, a CRC, an interface module maker ID and its data index (the data index is an item of data which represents what the following item of data is), a flag indicating the capability of a node (here the device 20), the address of a node-unique ID (which

15 includes the maker ID and serial number of the node) and the address of the unit directory.

As shown in Fig. 3, the unit directory stores a flag indicating the size of the unit directory, a CRC, a device maker ID and its index, the software version of

20 the system controller of the printer and its index, and the address of the unit-specific information directory and its index.

As shown in Fig. 4, the unit-specific information directory stores a flag indicating the size of the unit-

25 specific information directory, a CRC, a command address, and its index, used when a command is transmitted from the device controller 10 to the device 20, device maker name and its index, device model name

and its index, and the address of the software
information directory and its index.

As shown in Fig. 5, the driver-software information
directory stores the data length of the data that has
5   been stored in the driver-software information
directory, a CRC, the corresponding OS (operating
system) name of the driver software and its major
version number and minor version number, and the storage
address of the driver software. Since driver software
10   of a plurality of types has been stored in the driver-
software archive area, as will be set forth below, a
corresponding OS name of the driver software, major
version number, minor version number and driver software
storage address also are stored in dependence upon the
15   type of driver software.

A plurality of types of driver software are stored
in the driver-software archive area illustrated in Fig.
6. Driver software of types "A", "B", "C" and "D" are
stored in areas specified by addresses ad1, ad2, ad3 and
20   ad4, respectively. Thus, in the communication system
according to this embodiment, a plurality of types of
driver software are stored in the driver-software
archive area, and driver software suited to the
operating system used in the device controller 10
25   connected to the device 20 is read out. The processing
involved will be described in detail later.

Installation of driver software in the device
controller 10 according to this embodiment will now be

described.

Fig. 7 is a flowchart illustrating the processing procedure for installing driver software.

With reference to Figs. 7 and 1, the maker name and model name of the device 20 connected to the device controller 10 are read (step 31). In order to read this information, first reference is had to the root directory shown in Fig. 2, whence the address of the unit directory is sensed. The unit directory is referred to based upon the address of the unit directory. The address of the unit-specific information directory is sensed from the unit directory. The unit-specific information directory is referred to based upon the address of the unit-specific information directory. The device maker name and device model name are sensed from the unit-specific information directory. The data representing sensed device maker name and device model name is read out of the EEPROM 24 and supplied from the device 20 to the device controller 10. The data representing the device maker name and device model name is stored temporarily in the main memory 15 of the device controller 10.

Next, it is judged whether driver software suitable for controlling the device 20 connected to the device controller 10 has been stored in the main memory 15 of device controller 10 (step 32). If the driver software has already been stored in the main memory 15 ("YES" at step 32), processing for installing the driver software

is unnecessary.   Processing is terminated as a result.

If the driver software has not been installed in the

main memory 15 ("NO" at step 32), it is judged whether

driver software suitable for controlling the device 20

5   has been stored in the EEPROM 24 of the device 20 (step

33).   This judgement is made by referring to the unit

directory of Fig. 3 based upon the root directory of

Fig. 2 and to the unit-specific information directory of

Fig. 4 based upon the unit directory in a manner similar

10   to that of the processing (step 31) for reading the

device maker name and model name.   The address of the

driver-software information directory is sensed from the

unit-specific information directory.   The driver-

software information directory shown in Fig. 5 is

15   referred to based upon this address.   It is judged

whether a name the same as that of the operating system

running on the device controller 10 and whether a

version number the same as or later than the version

number of this operating system have been stored in the

20   driver-software information directory.   When the same

name has been stored as well as the same or later

version number of the operating system, it is judged

that driver software suited to the device controller 10

has been stored in the EEPROM 24 of the device 20 ("YES"

25   at step 33).

If it is judged that driver software suited to the

device controller 10 has been stored in the device 20,

the storage address of the suitable driver software is

sensed from the driver-software information directory.
Data representing the driver software suited to the
device controller 10 is read out of the driver-software
archive area based upon the sensed address. The data

5 representing the driver software that has been read out
is transmitted from the device 20 to the device
controller 10 in accordance with IEEE 1394 (step 34).

The data representing the driver software is
received by the device controller 10 and stored in the

10 main memory 15. This completes the installation of the
driver software. Reading out the driver software that
has been stored in the main memory 15 makes it possible
for the operation (a printing operation, image data
reading operation, etc.) of the device 20 to be

15 controlled by the device controller 10.

If driver software suitable for control of the
device 20 has not been stored in the EEPROM 24 of the
device 10 ("NO" at step 33), then a message to this
effect and a message calling for installation of the

20 driver software are displayed on the display unit 14 of
the device controller 10 (step 35). In response, the
user loads a storage medium such as a floppy disk
storing the driver software suitable for control of the
device 20 into the floppy disk driver (not shown) of the

25 device controller 10, thereby performing installation.

In the embodiment described above, data transfer of
the driver software is carried out based upon IEEE 1394.
However, it goes without saying that the data transfer

may be performed based upon another standard.

If the device 20 in the above-described embodiment is a digital video camera, plural types of driver software would be stored in the digital video camera and

5 the driver software suitable for controlling the camera would be read out of the camera and transmitted to the camera controller (device controller). If the device 20 is a printer, then plural types of driver software would be stored in the printer and the driver software

10 suitable for controlling the printer would be read out of the printer and transmitted to the printer controller (device controller).

Further, in the embodiment described above, driver software suited to the device controller 10 is

15 transmitted from the device 20 to the device controller 10. However, data representing the address of the location storing this driver software and data representing the operating system for operating this driver software may be transmitted to the device

20 controller 10 in addition to the driver software. This will make it possible to read out the driver software again merely by referring to these items of data, ~~speedy~~.

(2) Second embodiment

25 Fig. 8 illustrates a second embodiment of the present invention.

As shown in Fig. 8, a charging apparatus 40, a personal computer 60 and a communication apparatus 70

are interconnected by a cable 50 in accordance with IEEE

1394. The cable 50 includes a signal line 52 for

transmitting data and a power supply line 51 for

supplying electric power. The cable 50 includes a

5   ground line as well, though this is not shown. Though

there are four signal lines in actuality, here only one

is shown in order to simplify the drawing.

     The overall operation of the charging apparatus 40

is supervised by a CPU 41. A ROM 42 storing data to be

10   sent to and received from the personal computer 60 is

connected to the CPU 41. A communication control

circuit 45, which is for sending and receiving data in

accordance with IEEE 1394, is also connected to the CPU

41. The communication control circuit 45 is connected

15   to the signal line 52.

     The charging apparatus 40 includes a charging

circuit 43 for charging a battery 48. The charging

circuit 43 is connected to the power supply line 51 and

charges the battery 48 by electric power supplied from

20   the power supply line 51. The power supply line 51 is

connected to a monitoring circuit 44 as well in order

that the electric power supplied from the power supply

line 51 may be monitored. Data representing the status

of the electric power (i.e., where it is equal to or

25   greater than a fixed level) supplied from the power

supply line 51 is applied from the monitoring circuit 44

to the CPU 41. It should be noted that a cable for

supplying electric power from an external power source

is not connected to the charging apparatus 40.

The overall operation of the personal computer 60 is supervised by a CPU 61.

The personal computer 60 also includes a
5 communication control circuit 63 capable of sending and receiving data in accordance with IEEE 1394 and connected to the cable 50. The communication control circuit 63 is controlled by a controller 62. The controller 62 is controlled by the CPU 61.

10 The personal computer 60 includes a power source unit 64. By plugging an AC plug 65 into the socket of a commercial power supply, 120-volt AC voltage is applied to the power source unit 64. The power source unit 64 converts the 120-volt AC voltage to a DC voltage of 8 to
15 40 volts. The power source unit 64 also is connected to the power supply line 51. The converted DC voltage of 8 to 40 volts is supplied to the power supply line 51, whereby the DC voltage is supplied as power for driving the charging apparatus 40 and communication apparatus 70
20 connected by the cable 50. It goes without saying that the DC voltage obtained by the conversion in the power source unit 64 is supplied as driving voltage to each of the components of the personal computer 60.

The operation through which charging is carried out
25 by the charging apparatus 40 will now be described.

Whether the cable 50 in accordance with IEEE 1394 has been connected between the charging apparatus 40 and personal computer 60 or not is monitored by the

communication control circuit 45 of the charging

apparatus 40 and the communication control circuit 63 of

the personal computer 60. If the cable 50 has been

connected between the charging apparatus 40 and personal

5 computer 60, a bus reset is performed and self-

identification packets of the kind shown in Fig. 9 are

transmitted mutually between the charging apparatus 10

and personal computer 60. (Self-identification packets

naturally are transmitted between the communication

10 apparatus 70 and personal computer 60 as well.)

First through fourth self-identification packets

are transmitted in dependence upon the number of ports

to which the cable 50 is connected. Here it is assumed

for the sake of simplicity that one self-identification

15 packet is transmitted.

As shown in Fig. 9, an area 10 of the packet stores

the identifier of the self-identification packet, an

area phy ID stores an identifier specific to the

apparatus that transmits this self-identification

20 packet, an area 0 stores data indicating that this is

the first self-identification packet, an area L stores

data indicating whether the communication control

circuit of the apparatus that transmits the self-

identification packet is in a state in which it can

25 receive data, an area gap cnt stores data relating to a

threshold value used in judging a sub-action gap and an

arbitration gap, etc., in data transfer in accordance

with IEEE 1394, an area sp stores data representing

capability relating to data communication speed, an area
de1 stores data relating to delay time which occurs in a
case where an apparatus that has received data transfers
the data to another apparatus, an area c stores data

5   representing whether a bus manager and isochronous
resource manager can be implemented in data transfer in
accordance with IEEE 1394, an area pwr stores data
indicating whether this apparatus has the ability to
supply electric power, as well as data indicating

10   maximum power consumption, areas p0 to p2 store data
relating to whether another apparatus is connected to
the port of this apparatus as a higher order apparatus
or as a lower order apparatus hierarchically speaking,
an area i stores the self-identification packet of the

15   apparatus which began bus reset first, which packet
includes data relating to this fact, and an area m
stores data indicating whether a self-identification
packet is to follow.

Self-identification packets of this kind are

20   transmitted between the charging apparatus 40 and
personal computer 60 at occurrence of bus reset. When
the charging apparatus 40 receives the self-
identification packet transmitted from the personal
computer 60, the charging apparatus 40 senses the power

25   supplying capability of the personal computer 60 stored
in the area pwr of this self-identification packet. The
sensed power supplying capability and the maximum power
consumption of the charging apparatus 40 (the relevant

data having been stored in the ROM 42) are compared. If
the power supplying capability exceeds the maximum power
consumption, the battery 48 is charged by the charging
circuit 43. If the power supplying capability is less

5 than the maximum power consumption, on the other hand,
charging of the battery by the charging circuit 43 is
inhibited.

In a case where the communication apparatus 70,
which is a communication apparatus other than the

10 charging apparatus 40 and the personal computer 60, are
connected by the cable 50 in accordance with IEEE 1394,
there are instances where data representing the power
supplying capability of the communication apparatus 70
will be applied to the charging apparatus 40 regardless

15 of the fact that the electric power is being supplied
from the personal computer 60. In such case a situation
may arise in which the electric power actually provided
by the personal computer 60 falls below the maximum
power consumption of the charging apparatus 40. In

20 order to prevent this situation, the monitoring circuit
44 in the charging apparatus 40 shown in Fig. 8 monitors
the level of the power supplied from the power supply
line 51. If the CPU 41 judges on the basis of the
signal output by the monitoring circuit 44 that a

25 voltage drop will be caused by charging carried out by
the charging circuit 43, the charging circuit 43 is
controlled by the CPU 41 so as to perform charging to
such a degree that will not cause a drop in voltage.

The personal computer 60 also compares the maximum power consumption and power supplying capability stored in the area pwr of the self-identification packet transmitted from the charging apparatus 40. If

5   required, the personal computer 60 terminates the supply of electric power to the charging apparatus 40.

It goes without saying that data (e.g., data relating to the state of charging) is sent and received by the charging apparatus 40 and personal computer 60 in

10   Fig. 8 through the signal line 52 included in the cable 50.

Fig. 10 is a block diagram illustrating another embodiment of the present invention and showing a charging apparatus 40A, which has been connected to a

15   digital camera (data processing unit) 80, and the personal computer 60 connected to the charging apparatus 40A by the cable 50 in accordance with IEEE 1394. Components identical with those shown in Fig. 8 are designated by like reference characters and are not

20   described again.

The charging apparatus 40A shown in Fig. 10 is formed to have connectors 46 and 47 by which the charging apparatus 40A and the digital camera 80 are electrically connected to each other. Electric power

25   supplied from the charging circuit 43 is applied to the connectors 46. The connector 47 is connected to the CPU 41.

The digital camera 80 includes a controller 81 and

sends and receives data to and from the charging

apparatus 40A via the connector 47. (Though the digital

camera 80 includes a variety of circuits, they are not

illustrated here as they have no direct bearing upon the

5   present invention.) The battery 48 serving as the

driving power supply is installed in the digital camera

80. The two ends of the battery 48 are connected to the

connectors 46.

By thus connecting the charging apparatus 40A to

10   the digital camera 80, the battery 48 installed in the

digital camera 80 can be charged using the charging

circuit 43 included in the charging apparatus 40A.

As many apparently widely different embodiments of

the present invention can be made without departing from

15   the spirit and scope thereof, it is to be understood

that the invention is not limited to the specific

embodiments thereof except as defined in the appended

claims.